

Fundamental Research into Hyperelastic Materials for Flight Applications (FY15)

Completed Technology Project (2013 - 2015)



Project Introduction

This research project is working to develop methods to characterize elastomer materials for flight applications as well as instrumentation methods to monitor their use in flight. These hyperelastic materials have long been used in specialized applications where their flexibility is essential (e.g., O-rings and gaskets for pressure retention), but they are now being considered for use as load-bearing structural elements. Because little data are available in the aerospace community for designing structures that incorporate elastomer materials, Armstrong researchers are evaluating elastomer stress-strain behavior under various loading scenarios to aid in their incorporation into structural designs. This research is part of an innovative effort to use hyperelastic materials to produce flexible and seamless aircraft structures that reduce drag and minimize acoustic noise.

Work to date: Researchers developed a uniaxial test rig to evaluate elastomer materials. Applying uniaxial loads allows the stress-strain curve to be produced using photogrammetric techniques. The photogrammetry system can also be used to assess liquid strain gauge performance. The resulting tensile-testing technique enables elastomer material characterization for flight applications.

Looking ahead: Test data obtained in 2014 will support future analysis studies scheduled for 2015. In addition to planned fundamental analysis studies, vibration studies will validate elastomer modal characteristics.

NASA Partner: Langley Research Center

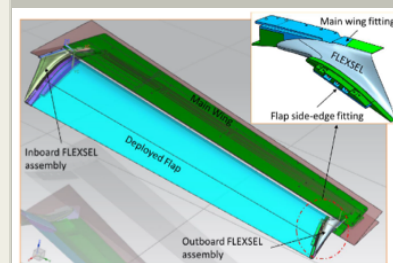
Benefits:

- **High performance:** Improves aerodynamic capabilities and enables morphing structural technologies by sealing structural gaps
- **Quieter:** Reduces airframe noise associated with takeoffs and landings, both in the aircraft cabin and on the ground
- **Economical:** Increases fuel efficiency by reducing drag

Applications:

- Aircraft wing flaps
- Helicopter blades
- Motor vehicles, trains, and ships

Anticipated Benefits



Wing rendering with Flexible Side Edge Link (FLEXSEL)

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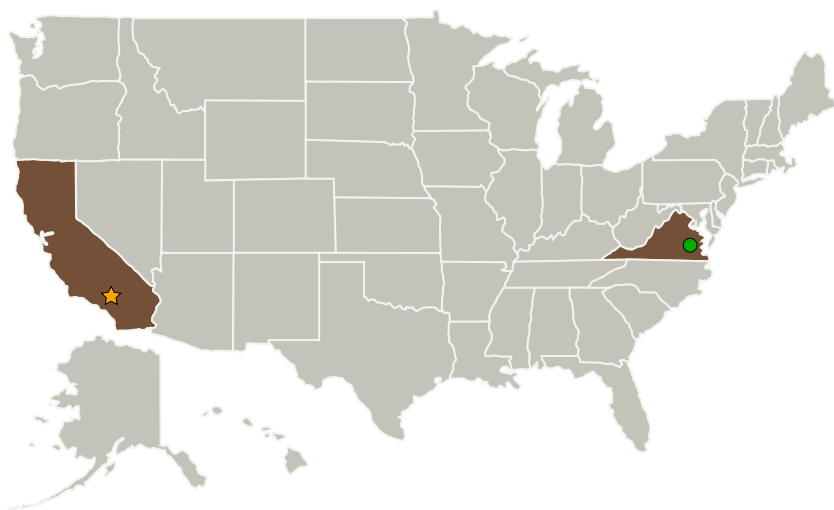
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Armstrong Flight Research Center (AFRC)	Lead Organization	NASA Center	Edwards, California
● Langley Research Center (LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

California	Virginia
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Center Innovation Fund: AFRC CIF

Project Management

Program Director:

Michael R Lapointe

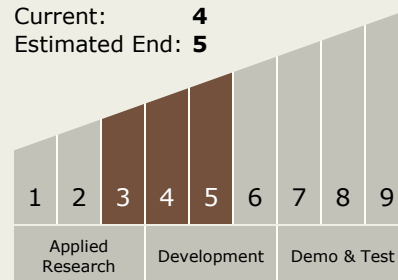
Program Manager:

David F Voracek

Principal Investigators:

Claudia Y Sales
Eric J Miller

Technology Maturity (TRL)

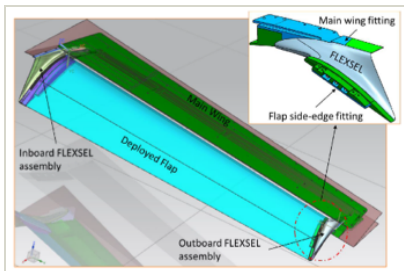
Start: **3**
Current: **4**
Estimated End: **5**

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Images



Hyperelastic Research

Wing rendering with Flexible Side Edge Link (FLEXSEL)

(<https://techport.nasa.gov/image/16621>)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.1 Materials
 - └ TX12.1.3 Flexible Material Systems